Operational Report of a Mobile Fresh Fish Packing Plant

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December 1982

Canadian Industry Report of Fisheries & Aquatic Sciences No.135

Canadian Industry Report of Fisheries and Aquatic Sciences

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This is the second Industry Report
from the Western Region, Winnipeg

PREFACE

The mobile fish plant project was initiated in the latter part of 1976 prior to Canada's total conversion to the metric system. Except for temperature and distance measurements, English units are used throughout the text because the plant was specified and constructed using the English system. In some cases, the metric equivalent is shown in brackets.

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Cat. no. FS 97-24/135 ISSN 0704-3694

Correct citation for this publication is:

Friesen, A. 1982. Operational report of a mobile fresh fish packing plant. Can. Ind. Rep. Fish. Aquat. Sci. 135: iv + 17 p.

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ABSTRACT

Friesen, A.R. 1982. Operational report of a mobile fresh fish packing plant. Can. Ind. Rep. Fish. Aquat. Sci. 135: iv + 17 p.

A field test was carried out on a prototype mobile fish packing plant during a three year period from March 1977 to March 1980.

The prototype was constructed according to plans detailed in a previous technical report examining the physical feasability of mobile fish processing plants.

The plant consists of two 10 feet by 52 feet (3.05 m x 15.85 m) trailers equipped with all the necessary support equipment to operate a fish packing plant in remote areas.

This report discusses the designs specifications, operational problems and their solutions, and the economics of the project.

Key words: processing fishery products; fishery technology; preservation (fishery products).

RESUME

Friesen, A.R. 1982. Operational report of a mobile fresh fish packing plant. Can. Ind. Rep. Fish. Aquat. Sci. 135: iv + 17 p.

On a fait l'essai pratique d'un prototype de conserverie de poisson roulante pendant trois ans, soit de mars 1977 à mars 1980.

Le prototype fut construit selon les plans énoncés dans un rapport technique visant à déterminer la possibilité de construire des conserveries de poisson roulantes.

La conserverie occupe deux semi-remorques mesurant 10 pieds sur 52 pieds (3,05 m sur 15,85 m) et comprend tout le matériel de soutien nécessaire à l'exploitation dans les régions éloignées.

Ce rapport étudie les dessins et les devis, les problèmes d'exploitation et leurs solutions, ainsi que les aspects financiers du projet.

Mots-clés: traitement des produits de la pêche; technologie des pêches; conservation des produits de la pêche.

INTRODUCTION

This report is a follow-up to the Technical Report #634 written by W.L. Dilk entitled "Investigation of the Physical Feasibility of Mobile Fish Processing Plants". Report #634 describes several different configurations and layouts for the trailers. The Department of Fisheries and Oceans selected the "Fresh Fish Packing Plant Option" as the layout for prototype construction and testing. Testing was conducted with the aim of demonstrating the physical and economic feasibility. Funding was made available through the Federal Government and the work carried out by the Fisheries Development Group of the Industry Services Branch of the Department of Fisheries and Oceans in Winnipeg. This group is responsible for the administration of gear development, product development, market promotion, engineering research, exploratory fishing, technology transfer and field engineering programs.

OBJECTIVE

The objective of the project was to design and construct a mobile fish packing plant prototype and conduct a three year operational test to demonstrate the physical and economic viability of its operation.

CONCEPT

The Industry Services Branch of the Department of Fisheries and Oceans in the Western Region covers an area consisting of Manitoba, Saskatchewan, Alberta and the Northwest Territories. The inland fishery in this Region has traditionally faced a problem of generating limited capital funds for new fish plant construction. The fishery, for the most part, is comprised of numerous small lakes with specific catch limits or quotas per lake. Several hundred lakes and locations individually harvest 200 000 pounds of fish or less during any given season, many in a period from two to six weeks. The funding problem becomes more acute for smaller lakes which generate even less capital for construction of permanent shore facilities. These facilities are desirable to maintain sound fish quality and comply with government regulations.

Since processing plant capital construction costs may exceed an estimated $65 000 (1977 dollars) for lakes approaching a 200 000 pound quota, and the revenue generated results in a net operating loss, a new approach for servicing these lakes was needed. Furthermore, in areas where some processing is desirable as opposed to simply packing and holding, the situation becomes even more serious. The introduction of the mobility concept for a fish plant offered alternatives previously unavailable to fishery co-operatives, agents and companies. This concept was also an attractive alternative for use in provincial and federal parks where permanent facilities are not encouraged or allowed.

Initial projections indicated that the mobile plant would replace up to eight permanent plants per year. This would be possible by progressively following the fishing seasons as they change throughout the provinces.

SELECTED DESIGN OPTION

One of the designs described in the report investigating the feasibility of a mobile fish processing plant (Dilk 1976) is the "Fresh Fish Packing Plant Option" as described on page 20 of that report. This concept proposes using a "receiving" trailer and a "preliminary process or holding" trailer as a mobile fresh fish packing plant, which would eliminate the need for permanent lakeside packing plants. This option was selected for construction because it would help verify all the concepts described in the report as well as attempting to solve the need for capital investments in permanent lakeside plants as previously described.

PLANT LAYOUT AND DESIGN CRITERIA

A general layout of the system as it would appear set up at lakeside is shown in Fig. 1 and a more detailed drawing of various interior components is shown in Fig. 2. Appendix 1 contains detailed construction and component specifications illustrating how the entire system was built as well as itemizing the costs.

The basic concept was for one trailer to receive the fish as they arrived from the lake and the other trailer to hold the fish until enough product was available to fully load a refrigerated semi-trailer vehicle for shipping to a central plant for further processing.

The following criteria served as a basis for construction of the prototype:

1. The plant would have to be totally self-contained in order to move into remote areas with virtually no support facilities.
2. The design would have to be rugged enough to withstand the rough characteristics of roads in remote areas.
3. It would contain features required to maintain fish quality and cope with the variety of possible production problems that could be encountered in the field.
4. Disposal of waste water year round.
5. Provide power generation to adequately operate the necessary equipment with sufficient fuel storage for several days operation.
6. Provide sufficient engine room ventilation to eliminate heat buildup during summer operation.
7. Provide a rugged waterproof, noncorrodible interior including non-skid flooring, waterproof electrical outlets, mechanical exhaust to avoid condensation and water resistant finish throughout.
8. Provide adequate work area to conduct the packing operation.

9. Meet the criteria of the Fish Inspection Regulations (1978) for registered fish processing plants. The requirement for a nine foot ceiling height has been waived due to the experimental nature of the project and the expense of nonstandard trailer construction.
10. Provide the specific design features necessary to ensure the following:
    - sanitary operating conditions,
    - the capacity to freeze fish quickly in case of delivery delays and hold them at -25 C,
    - capability to hold fresh fish at 4 C for up to five days,
    - to provide adequate ice-making facilities capable of producing one pound of ice for every pound of fish received,
    - to provide pressurized hot and cold water chlorinated for sanitation,
    - to be able to maintain interior working conditions above 8 C in winter,
    - to maintain fish holding conditions above freezing and provide continuous water supply from a lake source in freezing temperatures.

During the design stage of the project, several features were incorporated into the plant, the advantages of which may not be immediately obvious. Some of these features are listed below.

1) Roller Conveyor System
   - 10-foot aluminum roller conveyor sections were used to reduce the total weight of the trailers during moving, reduce the effort required during assembly, and resist corrosion during use.
   - 10-foot heavy duty galvanized steel roller conveyor sections were employed only in high use areas where fish tubs were loaded or unloaded.
   - Tripod-type metal stands were used to support the conveyor system. The tripod design improves stability on uneven surfaces.

2) Water Pressure System
   - Four Jacuzzi hydrocels maintained the system water pressure when the water pump is not running. The hydrocels require little maintenance and require no adjustments during start-up at each new site.
   - A chemical feeder is used to chlorinate lake water used for processing and wash-up procedures.

3) Power Generator
   - A transfer switch has been provided to allow easy electrical hook-up to an alternate electrical supply when available, thus reducing the use of the diesel generator.

4) Ice Machines
   - Two small ice machines producing 4000 lb/24 h each were selected as opposed to one large machine in order to provide ice production should one machine fail and also to provide economical capacity control during periods of light production.

5) Holding Room
   - The temperature of the holding room is adjustable over a range of -25 C to +10 C. The normal holding temperature is 4 C, but if unusually long delays are encountered, the product can be frozen and held in good condition.
   - If the plant becomes overloaded with product due to high production rates, the Thermo-King cooling unit has been selected with enough capacity to cool both trailers to approximately 4 C. This is accomplished by opening the holding room door and allowing the cold air to circulate throughout the plant.

SYSTEM CAPABILITIES AND PHYSICAL DATA

Production Data
- Maximum packing capacity of 21 120 lb/24 h. The storage space and limited ice production are the limiting factors.
- Accommodates up to six dressers if required.

Physical Dimensions and Weights

Receiving Trailer (see Fig. 2)

- Nominal exterior dimensions (excluding hitch)	10 ft	x	52 ft
- Receiving room	41 ft	x	9 ft
- Mechanical room	11 ft	x	9 ft
- Ceiling height	8 ft		
- Weight (including equipment)-axles			20 064 lb
-hitch			13 534 lb
			33 598 lb

Holding Trailer (see Fig. 2)

- Nominal exterior dimensions (excluding hitch)	10 ft	x	52 ft
- Ice bin (irregular shape) approximately	12 ft	x	9 ft
- Icing room	15 ft	x	9 ft
- Holding room	25 ft	x	8.75 ft
- Ceiling height	8 ft		
- Weight (including equipment)-axles			20 416 lb
-hitch			9 222 lb
			29 638 lb

Ice Making and Storage Capacity
- Two ice flaker units each capable of producing 4000 lb/24 h.
- Approximate storage capacity of ice bin is 20 000 lb.

Holding Room Capacity
- Maximum storage of 352 plastic tubs stacked five high.
- Total fish storage capacity of 21 120 lb. This assumes a loading density of 60 lb of fish per tub.

TYPICAL SYSTEM OPERATION AND SITES SERVICED

During the three year test period (March 1977 to March 1980) the mobile plant was used primarily as a fresh fish packing plant. However, during the test period, the plant was modified to incorporate the processing of whitefish

roe. The two operations were conducted as follows:

1) Fresh Fish Packing Plant Operation
   - Fishermen arrive at dock (A, Fig. 1) where they off-load the plastic tubs of iced fish (B) which are normally headed and gutted on the lake.
   - The tubs are placed on the roller conveyor (C) and manually moved towards the mobile plant until they reach the electric power conveyor (D) located outside the receiving entrance of the plant.
   - The power conveyor raises the fish tubs high enough into the receiving end of the trailer to allow gravity to aid in moving the tubs throughout the plant.
   - Inside the receiving area (E) the fish are weighed, graded and the daily catch records are made for each fisherman.
   - Filleting tables (F) are available in the plant to continue further processing but this was seldom done on a large scale.
   - The fish are re-packed and re-iced in the tubs before making their way into the refrigerated holding room (G) of the holding trailer. The re-icing is normally completed in the icing area (H) in front of the ice bin.
   - The fish are held in the holding room until picked up by a refrigerated semi-trailer truck (J).
   - The truck is normally loaded at the large side door located near the far end of the holding room. Thus, the first product into the holding room is the first product to be shipped.

2) Whitefish Roe Processing and Fresh Fish Packing Plant Operation
   - The products are received into the plant in the same fashion as previously described. The fishermen generally remove the roe sacs from the fish and deliver them to the plant in separate tubs.
   - The roe is inspected, weighed, and the data recorded.
   - The roe is immediately moved to the holding room area (G) which is now utilized as a roe processing area. (Extra lighting and water facilities have been added to this area to improve productivity and product quality.)
   - After the roe has been cleaned, salted, and packaged, it is stored in a refrigerated truck (K) parked adjacent to a side door of the holding trailer.
   - While the roe is being processed the fish are handled as before, except, they are moved directly into the refrigerated truck (K) for holding and shipping.

Table 1. List of the locations serviced and the type of processing conducted.

	Location	Process Type
1)	Deschambault Lake, Saskatchewan	Fish packing
2)	Montreal Lake, Saskatchewan	Fish packing
3)	Waterhen Lake, Saskatchewan	Fish packing
4)	Co-op Point, Saskatchewan	Fish packing
5)	Diefenbaker Lake, Saskatchewan	Fish packing and roe processing
6)	Beaver Lake, Saskatchewan	Fish packing
7)	William Lake, Manitoba	Fish packing and roe processing
8)	Diefenbaker Lake, Saskatchewan	Fish packing and roe processing
*	Prince Albert, Saskatchewan	Storage location for plant

Over the three year test period, the mobile plant serviced a total of eight sites in the order listed in Table 1 and shown in Fig. 3.

DEFICIENCIES

As with any new equipment, various types of operational and design problems were revealed on start-up. Some of the problems were relatively easy to solve, while others required too much investment to be cost effective at this time.

UNCORRECTED PROBLEMS

- Winter Operation
  Only one attempt was made to prove this concept. Unfortunately, the time chosen was the coldest part of the winter when the temperatures went as low as -40 C. Difficulties arose in keeping the generator operational, maintaining a good water supply, and keeping the plant clean.
  Some water lines ruptured due to freezing temperatures and plant cleanliness suffered since the aluminum flooring remained below freezing causing a build-up of ice. However, under more normal winter temperatures (averaging -17 C or higher) the plant could operate satisfactorily.
- Water Drainage
  In order to reduce the initial capital cost of the plant, the interior floors were not sloped towards the drains. This produced a greater sanitation problem and employee hazard than originally anticipated since constant attention had to be given to removing pools of standing waste water. The situation was marginally improved by installing small catch basins around the existing drains. Floors sloped to gutter drains provide the best solution, and should be included in any future construction. In addition, the aluminum checkerplate flooring had been screwed to the sub-flooring, allowing water to penetrate past the screws to the sub-floor and saturate the insulation. To correct this, the insulation was removed (causing problems for the winter operation) and carriage bolts and silicone sealant were used to hold the checkerplate to the sub-floor. This proved successful in stopping most of the leaks.
- Ice Bin Capacity
  The maximum ceiling height of the plant is eight feet. The ice machines were mounted

Table 2. Summary of financial and production data.

Year of Test	Operating Costs ($)	Total Income ($)	Operating Profit ($)	Production Rates Fish	Roe	Number Of Sites
1	45 853	46 707	824	549 483 lb	-	3
2	41 011	48 425	7 414	484 256 lb	-	2
3	30 315	50 976	20 661	407 034 lb	13 697 lb	3
Totals	117 179	146 108	28 929	1 440 773 lb	13 697 lb	8

as close to the ceiling as possible, but this left little room for ice storage beneath the machines. One possible solution was to cut a hole in the roof of the trailer and have the ice machines project part way through. This extra height could present problems during transit if low bridges are encountered. A mechanism to raise and lower the units could have been constructed, but would have been fairly complex due to the flexible refrigeration and water lines, etc., required. The problem was handled by storing ice in tubs in the holding room. Future construction should consider an auger system to transport ice to the ice bin.

CORRECTED PROBLEMS

- Axles and Tires
  The rough terrain covered during transport stressed the axles and tires beyond their design limits, resulting in bent axles and many ruptured tires. The solution was to up-grade the axles and tires.
- Hitches
  The original hitches on trailers were the pintle type, again chosen to reduce the initial cost. Due to the heavy tongue load and the overall weight of the units, the truckers objected to these hitches because of the stress and strain placed on their tractors. These hitches were replaced with heavy duty fifth wheel units specifically designed for heavy loads.
- Sewage Lines
  The initial design called for plastic sewage lines to be mounted below the framework of the trailers. This design proved satisfactory only when the units travelled on paved roads. However, when travelling on secondary roads, the piping was destroyed when negotiating dips in the road. The piping was relocated to run through the framework crossmembers and has not suffered any subsequent damage.

The cost required to rectify these deficiencies was approximately $15 000. A hidden cost is the additional operating expense incurred (especially in moving the trailers) prior to correcting the problems. For example, before changing the hitches, axles, and tires, the cost of moving peaked at $2.35/km/trailer, and after the changes, was reduced to an average of $1.26/km/trailer, a substantial saving.

PERFORMANCE EVALUATION

A total of eight fishing sites were visited during the three year test period, or approximately three sites per year. Note that this is considerably less than the projected 8 sites per year. Contributing factors to the reduction were:

1) Ever-increasing moving costs during the first year of operation increased the reluctance to move the system.
2) After one relatively unsuccessful winter operation, the plant was not used again during subsequent winters, thus decreasing the number of potential sites serviced per year.
3) Permanent facilities were constructed at a number of suitable sites in the region.

Table 2 summarizes the finances and production rates of the mobile fish plant during the three year test period. Appendix 2 contains more specific details.

The total income of $146 108 over the test period exceeds the operating costs (which do not include the initial capital cost or financing charges) by 25%. This good performance is encouraging particularly when dealing with a prototype system. The operating profit in excess of $20 000 during the final year of the test indicates that the modifications and operating experience have aided in streamlining the operation. Given the magnitude of the operating profit, capital cost payback is feasible, which indicates that the mobile fish plant is a financially viable concept. It should be noted that all of the revenue generated by the plant is a function of its production rate and packing allowance, thus making the financial viability very sensitive to changes in either of these variables.

If the mobile plant had not been constructed, the original capital expenditure ($132 440 plus) could have constructed three permanent fish packing plants. The overall financial picture for the three plants would probably be similar to that of the mobile plant. The permanent plants would have no moving expenses but this would be offset to some extent by land and building taxes and by duplication of support equipment at each site. Although the mobile plant did not meet the expected number of sites per year, it did service about three different sites per year with only one location being

visited twice. Thus, for almost the same cost as three permanent plants, a total of seven different locations were provided with a fish packing plant service.

Throughout the test period, the mobile plant has consistently produced a high quality product. This is especially true for the whitefish roe which must be processed rapidly and precisely. The development of whitefish roe production in the region has contributed significantly to improving the revenue generated by the plant.

The physical size of the trailers has proven adequate and the type and size of the support equipment has performed well.

The main body framework and the structure of the enclosure withstood the rigors of the test extremely well, and are in excellent condition with no visible signs of deterioration. With proper maintenance and care, the plant could remain in operation for at least ten years. At this point the plant could be sold or left at one site to provide a permanent facility.

SUMMARY AND CONCLUSIONS

The mobility concept for a fish packing plant was first examined in the technical report by Dilk (1976). This report discusses the physical feasibility of various configurations of mobile trailers for use as fish processing plants. In order to test both the economic and physical feasibility, the Federal Government funded the construction of a prototype unit described in the original report as the "Fresh Fish Packing Plant Option". The mobility concept in a packing plant allows the prototype to service many fishing sites which are presently unable to financially support a permanent type of plant.

A three year test period was selected to collect operating data (see Appendix 2) from the prototype. During the test period, the unit was used to pack and hold fish for shipment to processing plants. With the introduction of whitefish roe processing in the region, the mobile plant took on a dual role of fish packing and whitefish roe processing.

During the test period, the prototype was unable to service as many sites per year as was originally anticipated thus reducing its yearly productivity. In spite of the reduced productivity, the mobile fish packing plant concept appears to offer a physical and financially viable alternative to the permanent fish packing plant. In addition, the mobile plant can be used as a testing device to determine whether a certain lake or area has the production capacity to warrant a permanent facility. This feature can assist management in planning future growth patterns and in determining where to invest capital monies for maximum potential return.

The mobile plant is ideally suited to servicing fishing areas within provincial or federal parks where permanent facilities are discouraged or prohibited. Diefenbaker Lake is a prime example of such a location.

The approximate replacement cost of the mobile system including most of the modifications is approximately $215 000 as of March 31, 1981.

The operation and maintenance cost of the plant could be reduced if an operator with a vested interest in the plant was in control.

Many permanently located fish plants are subject to vandalism during the off-season. The mobile plant may be moved to a safe location thus avoiding this problem.

The mobile plant has demonstrated the physical feasibility of operating in remote areas. The unit is capable of servicing areas with no support facilities as well as areas having permanent plants that are in need of repair or have suffered equipment breakdowns at critical times.

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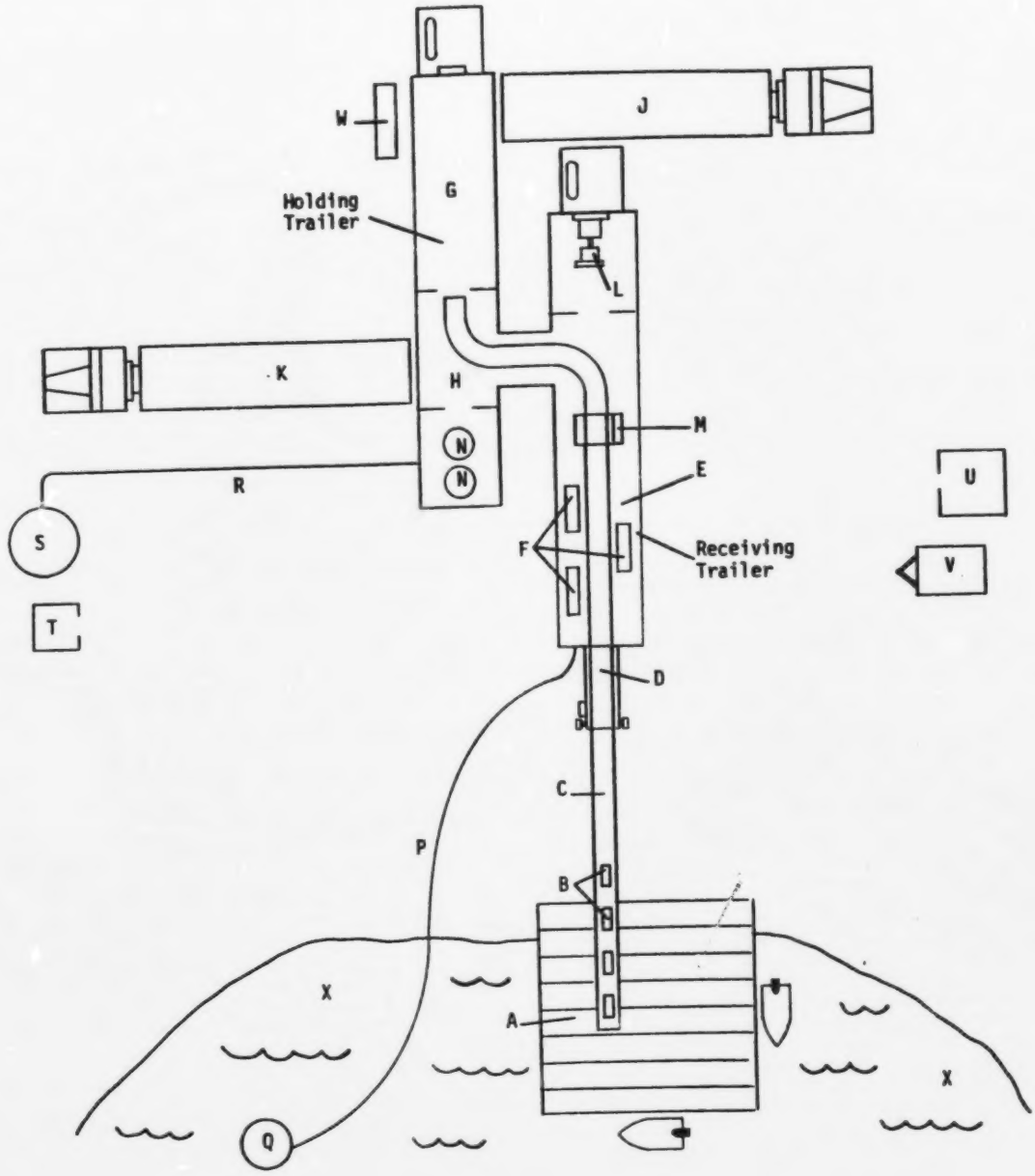

Fig. 1: System configuration at lakeside; A, Dock; B, Fish Tubs; C, Roller Conveyor; D, Power Conveyor; E, Receiving Area; F, Filleting Tables; G, Holding Room; H, Icing Area; J, K, Refrigerated Trucks; L, Diesel Generator; M, Weighing Scale; N, Ice Machines; P, Water Line; Q, Submersible Water Pump; R, Sewage Line; S, Seepage Pit; T, Privy; U, Dry Storage Building; V, Trailer for Manager; W, Fuel Storage Tank; X, Lake.

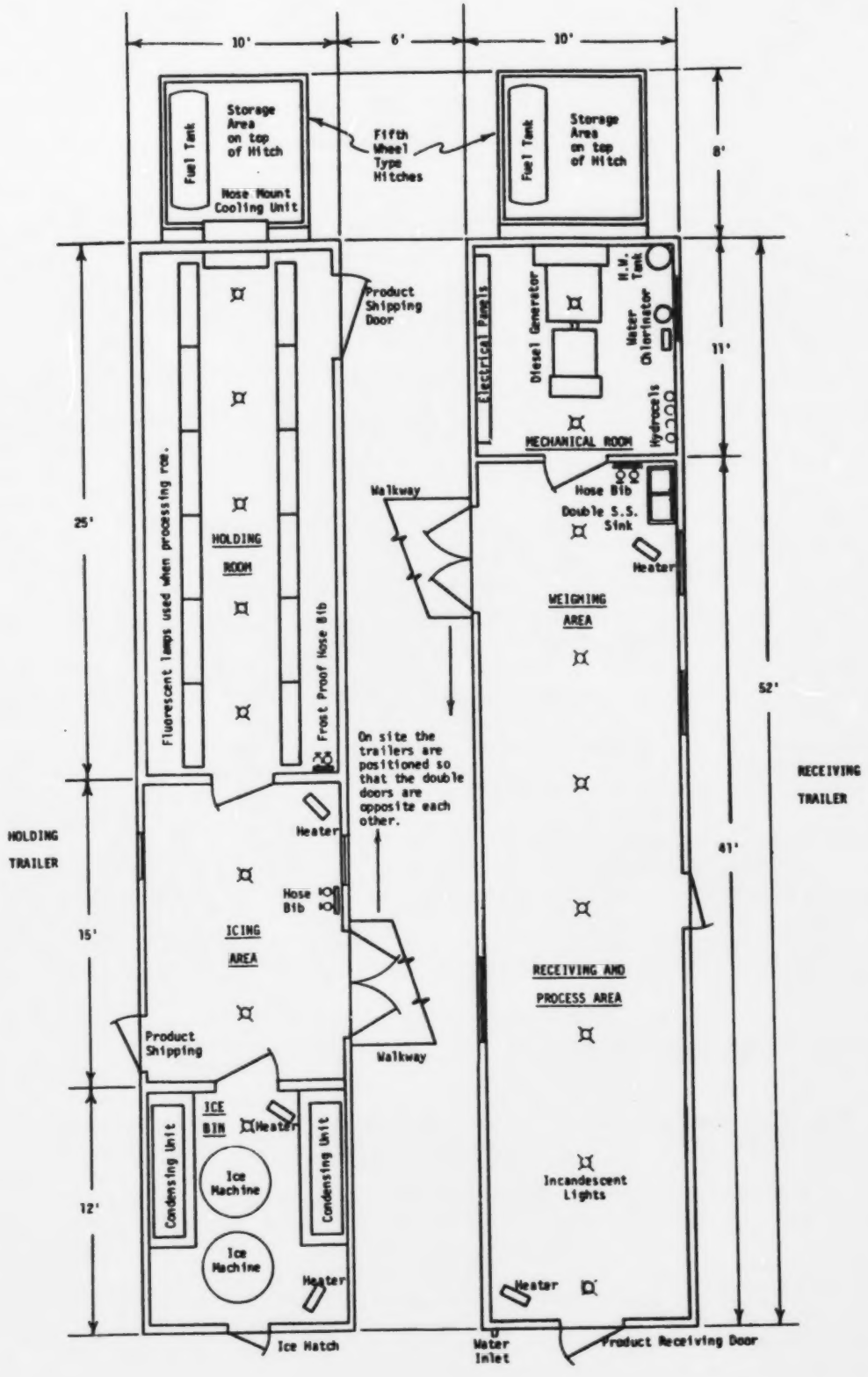

Fig. 2: Detailed interior view of mobile fish plant.

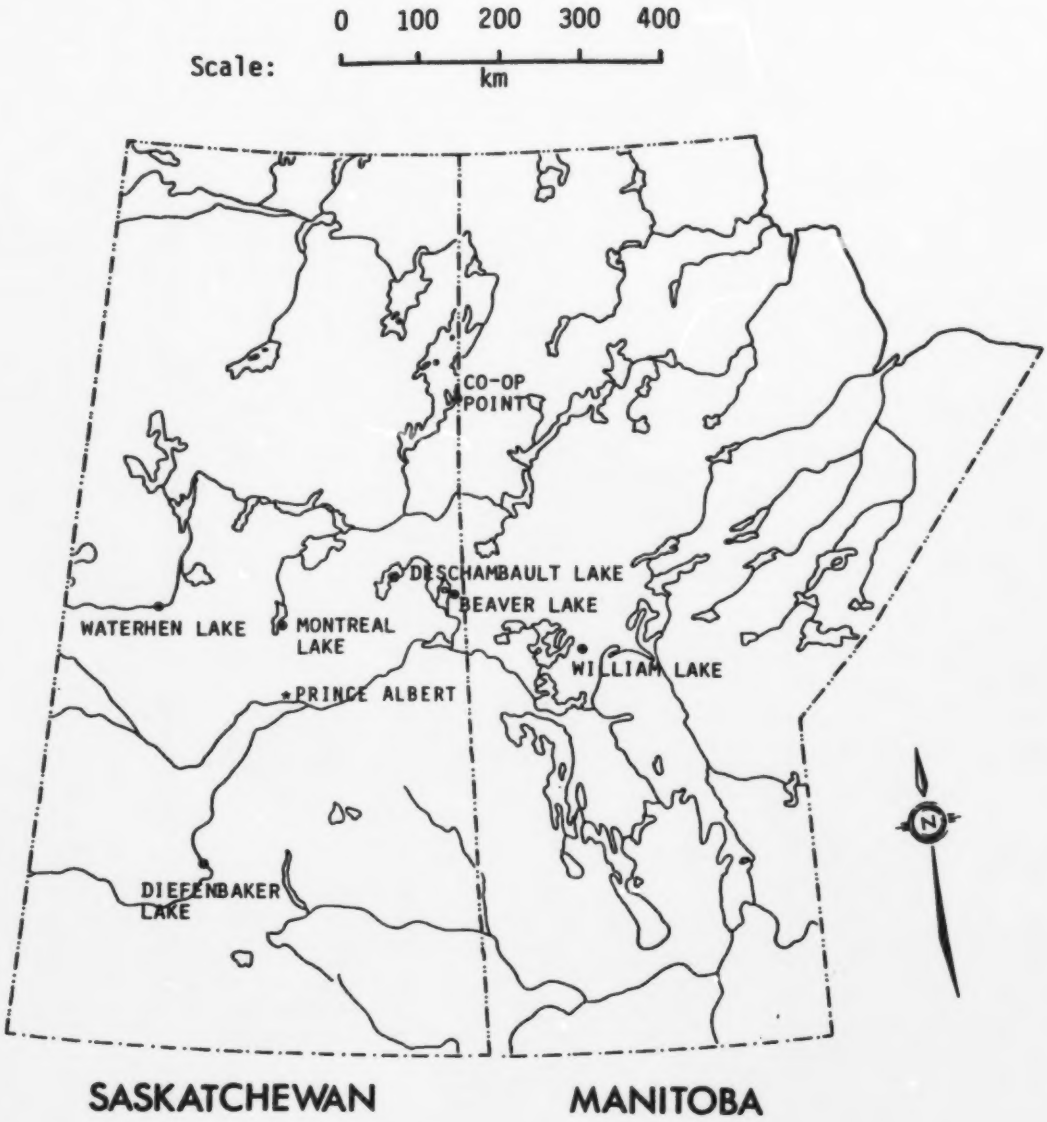

Fig. 3: Mobile plant locations during the three-year test period.

APPENDIX 1

System components, specifications, modifications and cost

TRAILERS
(Specifications include all modifications made to March 31, 1981)

a) Construction Specifications
- Two 10 ft x 52 ft trailers manufactured by Territorial Trailer Industries Ltd., in Edmonton, Alberta, Canada.
- 10 in channel two strand main frame, triple axle heavy duty suspension with a 7500 lb capacity for each axle, tire size 9.50 x 16.5 with a 10 ply rating, 8 stud wheels, and a fifth wheel hitch assembly.
- Three axle electric brakes, running lights, dock loading rubber bumpers at loading doors.
- 16 in on centre framing system, 2 x 8 wood floor joists, 2 x 4 walls in non-refrigerated areas, 2 x 6 walls in refrigerated areas.
- 3 1/2 in fibreglass in non-refrigerated areas except beneath the floor with 2 mil poly vapor barrier near the inside walls; 5 in fibreglass in refrigerated areas with 2 mil vapor barrier near outside walls.
- Floors, walls, ceilings, partitions finished with 5/8 in, good one side, fir tongue and groove plywood. Floor was flat with no slope to centre.
- Floors in all areas except mechanical room are standard gauge 3/16 in aluminum checkerplate rolled at the wall/floor joint extending up to approximately the 36 in level and sealed with 3M® caulking compound. Floor in mechanical room is steel checkerplate.
- Walls, partitions and ceilings are painted with two coats of Endura egg-shell white plastic as manufactured and applied by Dynamic Plastic Ltd.
- Exterior finish is 25 gauge baked white enamel aluminum siding with a green paint trim.
- Doors in non-refrigerated areas solid core metal sheathed, with raised sills. Doors in refrigerated areas, infitting, urethane insulated, flush to floor mounting. All hardware is heavy duty, refrigeration grade.
- Windows double glazed sliding aluminum with 50% screened opening.
- Aluminum checkerplate interconnecting walkway 4 ft x 6 ft, complete with walkway weather protection.
- Detachable heavy gauge access steps at two exterior doors.
- Louvered wall openings with manual dampers and bug screens in wall of mechanical room.

b) Mechanical Systems
- Thermo-King KWD30 Super 5105 diesel powered nose-mount refrigeration system for the holding room.
- Two Howe 20E ice flakers with a combined capacity of 8000 lb/24 h.
- Two Thermo-King XNWE electrically driven condensing units for ice flaker systems.
- Jacuzzi 1 HP 24.5 gallons/minute submersible pump complete with 200 ft x 1 in inside diameter pressure hose for summer usage and 200 ft x 1 in diameter insulated and heat traced pressure hose for winter usage.
- Jacuzzi hydrocel water pressure system utilizing four cells model #9190-7022.

- Culligan chemical feeder water chlorination system model CT10.
- Elco 53.1 Imperial gallon hot water tank with upper and lower 3kW 240/1/60 elements. (Only one element can be on at a time.)
- One floor mounted double compartment stainless steel sink with soap and towel dispenser.
- Type L 3/4 in copper hot and cold water piping system, surface mounted with nylon stand-offs. Interconnecting water lines between trailers made with cam-lock connectors and pressure hose.
- Hot and cold water bibs located in both trailers at suitable locations. Drain valving at all low points on pressure system to ensure complete drainage.
- 4 in PVC, drainage, waste and vent system connecting floor and sink drains. Piping located beneath the trailers running through frame cross members. Trailer drainage interconnected under the walkway, connected with plain end pipe couplings. All piping electrically heat traced and insulated for winter usage. Cleanouts provided at critical points.
- One 100 U.S. gallon diesel fuel tank mounted on each trailer hitch. One tank utilized for on-site fuel for the holding room diesel unit. The second tank for on site fuel for diesel generating plant.
- Sewage lift pump provided for pumping wastes to seepage pits. (On-site seepage pit consists of fibreglass septic tank sections buried vertically in the ground. The tanks are open at both ends and filled with a coarse aggregate as the seepage media.)

c) Electrical Systems
- Wakashaw/Scania diesel power plant (model D5A01) directly coupled to a Brown Boverie 50kW (62.5 kVA) synchronous generator all on a skid assembly, 120/230/3/60 power, control panel, instrumentation, main breaker and electronic speed control.
- 200 amp 120/230/3/60 4 wire main service.
- 200 amp manual transfer switch (to allow external power hook-up when available).
- 100 amp trailer subpanels.
- Receptacles and lighting inside and outside are vapour tight fixtures with the exception of the engine room.
- All lighting is incandescent. The holding room also includes two rows of fluorescent lamps running the full length of the room.
- The fluorescent lamps have the following specifications:
    - 4 ft long
    - two 40 watt tubes
    - -17.8 C ballast
    - opal acrylic shielding.
- All wiring, except in the mechanical room, wired with surface mounted PVC conduit and boxes.
- Twist lock receptacles and interconnecting cable is provided for power distribution between the trailers.
- Electric unit heaters are provided to maintain a minimum plant temperature of 8 C with a -40 C ambient temperature. Two 2 kW and three 5 kW heaters are provided.
- Two exhaust fans provide a minimum of four air changes/hour.

TOTAL COST OF ABOVE
(not including modifications) $132 440
(March 31, 1977)

SUPPORT EQUIPMENT

	Cost ($)
a) Furnishings for Mobile Plant	
- 18 - 10 ft aluminum roller conveyor sections	2 421
- 2 - 10 ft galvanized roller conveyor sections	293
- 3 - 90 degree aluminum roller conveyors	553
- 21 tripod stands for conveyors	462
- 1 hydraulic pallet jack	360
- 1 Toledo bench dial scale	1 777
- 1 aluminum stevedore (electrically driven)	2 066
- 3 - 3 ft x 5 ft stainless steel filleting tables with cutting boards	870
- 1 sewage disposal pump	200
- 1 - 20 ton levelling jack	100
- 4 spare tires and rims for mobile plant	440
- 300 plastic fish tubs	3 024
- Miscellaneous items including hoses, fire extinguishers, towel and soap dispensers, levelling blocks, etc.	1 000
	$13 566 (March 1977)
b) Material Required for each Site	
- 3 - 300 gallon fibreglass tanks to be used as seepage pits at various sites	830
- 3 - 12 ft x 12 ft storage sheds used for dry storage at various locations (material and labour)	2 898
- 2 privies	540
- 3 - 1000 gallon fuel tanks with hoses, filters, locks, and stands	1 869
	$6 137 (March 1977)
c) Living Quarters for Plant Manager	
- 23 ft Glenwood travel trailer equipped with a hot water heater, furnace, refrigerator, stove, shower, toilet, sink, tables and beds.	$6 297 (March 31, 1977)

MAJOR MODIFICATIONS

(These changes have been included in the specifications listed in Appendix 1 "Trailers" but the costs are listed below.)

- Replace existing axles and tires with heavy duty axles and tires	
- 6 axles complete with electric brakes	3 640
- 15 rims	840
- 15 - 9.50 x 16.5 10 ply tires	1 792
- installation and labour (includes modifying the wheel wells to accept larger wheels)	1 866
	$8 138 (March 31, 1979)
- Modify the hitches on both trailers to the fifth wheel type used on semi-trailer trucks.	3 000 / 3 000
	$6 000 (March 31, 1977)
- Raise the plastic sewage lines which run below the trailer frame to a position running through the frame crossmembers. This is to provide protection during transit.	585 / 585
	$1 170 (March 31, 1979)
- Install fluorescent lamps running the full length of the holding room. This is to provide sufficient lighting to process the whitefish roe.	$1 886 (March 31, 1981)
- Install an electronic governor on the diesel generator to prevent hunting during fluctuating electrical load demand.	$2 200 (March 31, 1981)

SUMMARY OF COSTS

Calculation of the approximate replacement cost of the entire system in 1981 dollars.

Note 1: In estimating the percent increase in the replacement cost occurring each year for the mobile plant, only the approximate value of inflation was used. These values were selected from Statistics Canada publications which list yearly cost increases for specific industries similar to those necessary to construct a mobile fish plant.

Note 2: In order to incorporate the cost of the major modifications into the replacement cost calculation, assume the modifications would cost 50% less if they had been included during the initial construction.

Item	Cost ($)
- 2 - 10 ft x 52 ft trailers	132 440
- Furnishing for trailers	13 566
- Materials for site locations	6 137
- Living quarters trailer	6 297
Cost as of March 31, 1977	$158 440
Assume 9% inflation between March 31, 1977 and March 31, 1978. (See Note 1)	158 440 14 260
Cost as of March 31, 1978	$172 700
Assume 7% inflation between March 31, 1978 and March 31, 1979	172 700 12 089
- Replace wheels and axles (50% of $8 138) - see Note 2.	4 069
- Modify hitches (50% of $6 000)	3 000
- Modify sewage lines (50% of $1 170)	585
Cost as of March 31, 1979	$192 443
Assume 5.4% inflation between March 31, 1979 and March 31, 1980	$192 443 10 392
Cost as of March 31, 1980	$202 835
Assume 5.2% inflation between March 31, 1980 and March 31, 1981	202 835 10 547
- Install fluorescent lamps (50% of $1 886)	943
- Install electronic governor (50% of $2 200)	1 100
Cost as of March 31, 1981	$215 425

APPENDIX 2

Data collected during the test

A three year test period was selected to determine the economics of the mobile fish plant project. Appendix 2 contains a chronological history of the expenditures and revenues generated over the period extending from March 31, 1977 to March 31, 1980. The approximate distance in kilometres from one location to another is also recorded. The Freshwater Fish Marketing Corporation, a Crown corporation, was contracted to operate the plant during the test period and provide operating costs, catch data, and revenues generated.

Date & Distance	Comments	Expenses ($)	Revenue ($)
March 31, 1977 (km = 0)	Mobile Plant completed in Edmonton Alberta. (start of test)		
June 3, 1977 (km = 1,008)	Both trailers set up at Deschambault Lake in Saskatchewan.		
	- moving expenses for 2 trailers (estimate)	1 260	
	- site preparation and gravel hauling	1 878	
	- hose extension for pump	119	
	- manufacture special sunken floor drains for plant	175	
	- service water pump	195	
	- fuel costs	737	
	- insurance	503	
	- plant labour	18 814	
	- repairs and maintenance	1 905	
	- catch data: pickerel 217 718; northern pike 70 804; tullibee 14 253; whitefish 45 420; 348 195 lb		
	- packing allowance 8.5¢/lb		
	- Revenue: 348 195 x 0.085		29 597
September 15, 1977 (km = 311)	Both trailers set up at Montreal Lake in Saskatchewan.		
	- moving expenses	582	
	- fuel	957	
	- repairs and maintenance	181	
	- plant labour and contract with manager	4 767	

Date & Distance	Comments	Expenses ($)	Revenue ($)
	- catch data:		
	pickerel 19 962		
	northern pike 3 900		
	whitefish 116 910		
	140 772 lb		
	- packing allowance 8.5¢/lb		
	- Revenue: 140 772 x 0.085		11 966
November 1977 (km = 118)	Both trailers temporarily stored in Prince Albert, Saskatchewan.		
	- moving cost	315	
December 1, 1977 (km = 282)	Both trailers set up at Waterhen Lake in Saskatchewan. (This was a test to determine the winter operating capability of the plant.)		
	- moving cost	556	
	- fuel	334	
	- plant labour	3 850	
	- repair and maintenance	3 029	
	- catch data:		
	pickerel 1 124		
	northern pike 3 395		
	whitefish 55 997		
	60 516 lb		
	- packing allowance 8.5¢/lb		
	- Revenue: 27 450 x 0.085		5 144
January 1978 (km = 282)	Both trailers stored in Prince Alberta, Saskatchewan.		
	- moving cost	556	
	- repair and maintenance	5 140	
March 31, 1978	End of year 1		
June 19, 1978 (km = 1,208)	Both trailers set up at Co-op Point in Saskatchewan.		
	- moving expenses	2 830	
	- set-up cost	1 100	
	- plant labour	11 028	
	- fuel	3 673	
	- catch data: 367 623 lb		
	- packing allowance 10.0¢/lb		
	- Revenue: 367 623 x 0.100		36 762

Date & Distance	Comments	Expenses ($)	Revenue ($)
September 25, 1978 (km = 1,558)	Both trailers set up at Diefenbaker Lake, Saskatchewan.		
	- moving expenses	7 320	
	- set-up cost	1 000	
	- plant labour	11 506	
	- repairs	753	
	- catch data: 116 633 lb		
	- packing allowance 10.0¢/lb		
	- Revenue: 116 633 x 0.100		11 663
November 1978 (km = 350)	Both trailers stored in Prince Albert for winter.		
	- moving expenses (estimate)	600	
	- repairs and maintenance	721	
	- storage charges	480	
	- Major modifications were completed at this time: 1) replace axles and wheels 2) modify hitches 3) modify plumbing These costs were added to the construction costs in Appendix 1 "Summary of Costs".		
March 31, 1979	End of year 2		
June 30, 1979 (km = 456)	The holding trailer was set up at Beaver Lake, Saskatchewan. (Receiving trailer remained stored in Prince Albert.)		
	- moving cost	650	
	- set-up cost	365	
	- plant labour	4 924	
	- fuel	325	
	- electric power	1 050	
	- catch data: 161 440 lb		
	- packing allowance 10.0¢/lb		
	- Revenue: 161 440 x 0.100		16 144
September 18, 1979 (km = 290)	The holding trailer was set up at William Lake in Manitoba. (Receiving trailer remained stored in Prince Albert.)		
	- moving cost	600	
	- plant labour	3 298	
	- fuel	125	

Date & Distance	Comments	Expenses ($)	Revenue ($)
	- catch data: 109 934 lb of fish 7 973 lb of whitefish roe - packing allowance 10.0¢/lb of fish 75.0¢/lb of roe		
	- Revenue: 109 934 x 0.100		10 993
	7 973 x 0.750		5 980
September 1979 (km = 746)	Holding trailer returned to Prince Albert, Saskatchewan.		
	- moving cost	836	
	- maintenance (estimate)	100	
October 1, 1979 (km = 350)	Both trailers set up at Diefenbaker Lake, Saskatchewan.		
	- moving cost	825	
	- set-up cost	1 000	
	- plant labour	7 688	
	- maintenance	3 807	
	- catch data: 135 660 lb of fish 5 724 lb of whitefish roe - packing allowance 10.0¢/lb of fish 75.0¢/lb of roe		
	- Revenue: 135 660 x 0.100		13 566
	5 724 x 0.750		4 293
December 1979 (km = 350)	Both trailers returned to Prince Albert for winter storage.		
	- moving cost	750	
	- tire repairs	202	
	- maintenance and repair	3 500	
	- storage charges	270	
March 31, 1980	End of three year test.		
	GRAND TOTALS	$117 179	$146 108

Note: The receiving trailer did not travel to sites where it was not required. Therefore, the total distance travelled for each trailer during the three year test is shown below.

Holding Trailer 7 309 km

Receiving Trailer 5 817 km

Printed in Canada by
Supply and Services Canada
Printing Office
for exclusive distribution by
Fisheries and Oceans
Freshwater Institute
Winnipeg, Manitoba
Canada